Development and test of the dual-gain ASIC preamplifier boards for the GLAST silicon-strip detectors

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Dual-gain ASIC preamplifier boards have been developed for the GLAST-type silicon trackers aiming at coincident measurements of heavy ions and protons from the breakup reactions in HI-proton experiments at SAMURAI.[1] The dual-gain ASIC chips were successfully tested in the previous HIMAC experiment[2] using a prototype printed-circuit board (PCB) with limited readout capabilities. The new design of the PCB has been developed in MTA Atomki (Hungary) in collaboration with RIKEN Nishina Center based on the previously established ASIC technology.

A single PCB is equipped with two ASIC chips for the instrumentation of 16 strips in total of a silicon-strip detector. Preamplified low-gain and high-gain output signals from the chips are separated on the PCB and sent to the external processing circuit HINP,[3] which implements triggering and amplifier functions for further signal processing. In addition, each PCB is equipped with an auxiliary connector, which distributes the test pulse signal as well as the bias voltage for the chips and silicons sensors. Four PCBs can be assembled into a compact stack-like structure, as shown in the Fig. 1, which can be mounted close to the silicon sensor to enable operation of the preamplifiers inside the vacuum chamber.

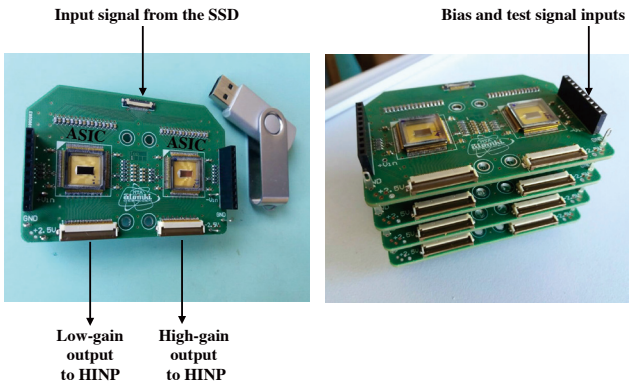

Fig. 1. Preamplifier boards for the GLAST silicon trackers. The left figure shows a single PCB. The right figure shows the assembly of the four PCBs into a compact stack.

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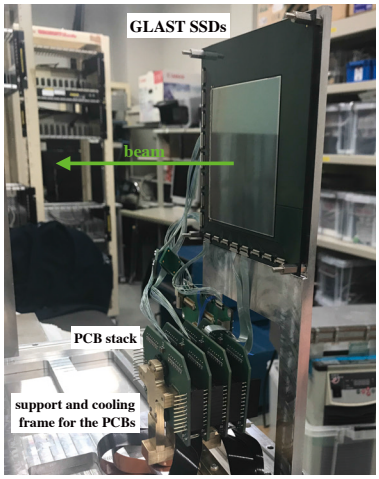

Fig. 2. Arrangement of the GLAST silicon detectors with preamplifier boards for the test experiment in HIMAC.

The four new preamplifier boards were manufactured in MTA Atomki and were sent to RIKEN for the test measurements. The test was carried out in the parasitic mode during the H391 experiment in HIMAC.[4,5] A double layer of the GLAST silicon detectors and the preamplifier PCBs were arranged together inside a vacuum chamber, as shown in Fig. 2. Thirty-two horizontal strips and 32 vertical strips were read-out by the PCBs. The entire structure was exposed to an incident beam consisting primarily of ^{6}He ions with a small contamination of ^{3}H and ^{9}Li particles at an energy of 123 MeV/nucleon and average beam rate of 2×10^{4} particles/second. The temperature of the ASIC chips was continuously monitored via a set of thermoelements integrated into the support structure in close proximity to the chips. The temperature stabilized around 36°C throughout the measurements.

The signals from $Z = 1$, 2, and 3 were successfully observed in the measurements, which allowed us to reconstruct the individual particle tracks in the silicon detectors. A detailed analysis of the experimental data is currently in progress.

References

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